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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/791,763	03/04/2004	Wolfgang Dettmann	0928.0036C	4420

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EDELL, SHAPIRO & FINNAN, LLC
1901 RESEARCH BOULEVARD
SUITE 400
ROCKVILLE, MD 20850

EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

MAIL DATE	DELIVERY MODE
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09/14/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/791,763	Applicant(s) DETTMANN ET AL.	
	Examiner John Ruggles	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 June 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3 and 5-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3 and 5-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 June 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

In the current 6/27/07 amendment, claims 1-3 and 5-8 remain pending as currently amended.

The previous drawings objections (i)-(iv), the previous specification objections (1)-(4), the previous claims objection (1), and the previous rejections of the claims under the second paragraph of 35 USC 112 are each withdrawn in view of the current amendment and the accompanying remarks. Also, the previous provisional obviousness-type double patenting (ODP) rejection of the claims is withdrawn in view of the current terminal disclaimer (TD) filed on 6/27/07, which has been accepted as indicated below.

However, Applicants' current arguments against the previous art rejection of the claims under 35 USC 103(a) are not sufficiently persuasive, so this rejection is maintained below.

Therefore, this Office action is made FINAL, as indicated below.

Terminal Disclaimer

The terminal disclaimer (TD) filed on 6/27/07 disclaiming the terminal portion of any patent granted on this (instant) application that would extend beyond the expiration date of any patent granted on application number 10/792,693 (Kohle et al., corresponding to US 2004/0197677) has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3 and 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pierrat (US 2004/0053141) in view of Kawamura (US 6,558,853) and Toublan et al. (US 6,807,662).

Pierrat teaches a set of masks including a first phase shift mask (PSM) and a second (trim) mask, as well as methods of using this set of masks in first and second overlapping exposures of the same photoresist on a semiconductor wafer (title, abstract, claims). The PSM can be an alternating PSM (altPSM, [0008], *instant claim 2*). Figures 5 and 6 illustrate a mask set in which the PSM for first exposure has a wider opaque line (505, 605) next to a critical feature (e.g., 606, etc.) and the corresponding trim mask for second exposure has a narrower opaque line (511, 611) at a corresponding position to allow space for mis-alignment. The second complementary trim exposure of the space can be sub-resolution [0012] (summary of invention, which reads on a trim mask pattern having a “dummy” structure). The second mask can include additional assist features or openings that are not located over the space created by the first PSM exposure, but still improve printing of the space ([0013], which reads on a further opening on the second trim mask, noting that a trim mask opening is often used to clear a phase conflict artifact from exposure with a PSM, *instant claim 3*). Figure 4 shows a mask set including an altPSM 102 and a corresponding trim mask 404. The altPSM 102 is represented with periodic

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alternating PS 106 (three or more) and non-PS 107 openings or gaps (two or more) of about the same first lateral dimension or first width separated by periodic opaque (e.g., chrome (Cr), etc. [0008] in reference to very similar Figure 1) lines or webs (four or more) of about the same second lateral dimension or second width (in which there are a total of at least five openings or gaps, there are at least four lines or webs, and the first and second lateral dimensions or widths are illustrated as being different from one another, *instant claims 5-6*) [0033]. In Figure 4, exposure through opening 402 may be "sub-resolution", which means that it will not print on its own, but when the second exposure through trim mask 404 is added to the exposure through the PSM 102, it improves the exposure of tight space 105, so that tight space 105 prints more reliably as is indicated by the arrow in aerial image 408 [0034]. The opening in the second (trim) mask can be sub-resolution (claim 16, page 4 right col., which reads on a trim mask having a dummy structure). Figure 5 shows an altPSM 502 having at least three alternating PS openings (non-PS 503, PS 505, non-PS 507) arranged as gaps separated by opaque chrome (Cr) lines (504, 506) in a periodic line-gap pattern (on the first mask [0036], *instant claim 5*).

Pierrat does not specifically teach that the PSM opening and the corresponding trim mask opening are each formed in a semitransparent layer nor other limitations of the instant claims.

Kawamura teaches an exposure mask having an auxiliary sub-resolution dummy pattern to reduce intensity of transmitted light distribution (abstract, Figures). The dummy pattern can be in an opaque film (e.g., chromium (Cr), etc.) on a (binary) mask or in an attenuating (semitransparent PS) film (e.g., molybdenum silicide (MoSi), etc.) on an attenuating PSM (attPSM, presumably as a dummy pattern in a semitransparent layer) to suppress the lowering of light intensity contrast of a desired pattern on either the binary mask or the attPSM (c2/L14-30,

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c3/L39-56). A conventional "reticule" (reticle or mask) "A" (having an open ratio of 80%) has a central transcribed periodic pattern film 11 having lines and spaces (L/S or a periodic line-gap pattern) surrounded by an open area 12 to produce lines and spaces (L/S) or periodic lines and gaps each having widths of 150 nm, but mask "B" has a sub-resolution dummy pattern film 13 (in previous open portion 12), to decrease total open area on the mask (to 60%) at a distance of 1 μ m from the L/S pattern film 11 to form lines and spaces (or lines and gaps) each having a width of 100nm on the wafer in a space of 140nm on the wafer (Figures 2A and 2B, c3/L66-c4/L9). As shown by Figures 3A and 3B, respectively, the exposure latitude (which may be analogous to the exposure process window) at the same depth of focus (DOF) of 0.4 μ m (400nm) is improved from 7% to 10% by using the mask "B" having a sub-resolution dummy pattern instead of the mask "A" without the sub-resolution dummy pattern (c4/L21-29).

Toublan et al. teach a mask set and a corresponding method of designing the mask set for a double overlapping exposure process of the same photoresist, in which the mask set includes a first mask and a second mask, and in which either the first mask or the second mask is a binary (trim) mask, an attPSM, or a combination thereof (abstract, c12/L12-14, c14/L45-47), as contemplated to save cost (c2/L39-41).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the mask set including a first mask and a second mask having a sub-resolution dummy structure or opening, in which either the first or the second mask is a PSM (e.g., an altPSM, an attPSM, etc.) and the other of the first and the second masks is a trim mask having a further opening for overlapping exposures of the same photoresist by the first and the second masks in either order (as taught by Pierrat and as contemplated to save cost by Toublan et al.) to have

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provided an additional separate sub-resolution dummy pattern positioned on the trim mask to correspond with each similar problem area on the PSM, because this would be expected to clear all applicable phase conflict artifacts from exposure of the photoresist with the PSM (as is often the reason for using a trim mask with a PSM in an overlapping double exposure method of the same photoresist, *instant claim 7*). It would also have been obvious to have included a semitransparent layer with a sub-resolution dummy pattern in addition to the main pattern on each of the first and the second masks, because a binary mask and a PSM (e.g., an altPSM, etc.) that each include an additional sub-resolution dummy pattern (e.g., in a semitransparent layer, etc.) for each main pattern on these masks (*instant claim 8*) would provide one of ordinary skill in the art with a reasonable expectation of success for (a) suppressing the lowering of light intensity contrast during exposure of each desired main pattern on the binary mask and/or the PSM and also for (b) improving the exposure latitude or process window achieved from each of these patterns on the binary mask and/or the PSM (as taught by Kawamura), while saving cost (as contemplated by Toublan et al., *instant claims 1-3 and 5-6*).

Response to Arguments

Applicants' current arguments filed on 6/27/07 have been fully considered, but they are not sufficiently persuasive. In the current amendment submission, in particular on pages 8-10 of 10, Applicants argue against the combination of Kawamura and Toublan et al. with Pierrat.

In response to Applicants' argument on pages 8-9 that Kawamura does not perform double exposure with two separate masks in which one mask has the transcribed (main) pattern and another separate mask has the semitransparent dummy pattern, the test for obviousness is not whether the features of a secondary reference (e.g., Kawamura, etc.) may be bodily incorporated

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into the structure of the primary reference (e.g., Pierrat, etc.); nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

In this case, Kawamura is not relied upon to show double exposure using a first mask and a second mask, which is already shown by Pierrat to include an altPSM and a separate trim mask (in either order to save cost, as taught by Toublan et al.). Instead, Kawamura teaches including a semitransparent layer with a sub-resolution dummy pattern in addition to the main pattern on the same mask (e.g., on each of the first and the second masks, etc.), because a binary mask and a PSM (e.g., an altPSM, etc.) that each include an additional sub-resolution dummy pattern (e.g., in a semitransparent layer, etc.) for each main pattern on these masks would provide one of ordinary skill in the art with a reasonable expectation of success for (a) suppressing the lowering of light intensity contrast during exposure of each desired main pattern on the binary mask and/or the PSM and also for (b) improving the exposure latitude or process window achieved from each of these patterns on the binary mask and/or the PSM.

Applicants assert that this combination would destroy the primary goal of Kawamura, but they are interpreting Kawamura in a different way than was set forth in the previous rejection, which is maintained above. Applicants argue that Kawamura's semitransparent dummy pattern and the transcribed main pattern would have to be on separate masks, but this is not the way Kawamura is relied upon.

In response to Applicants' argument on pages 9-10 that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining

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or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reasons for combining Kawamura's semitransparent dummy pattern with the main pattern on the same mask (each of the altPSM and/or the binary trim mask) in each of the first and second masks for the double exposure sequence taught by Pierrat and Toublan et al., was specifically stated and is repeated above.

Conclusion

THIS ACTION IS MADE FINAL. Applicants are reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

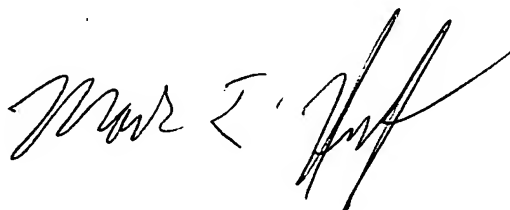
Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

jsr



MARK E. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1756